Ten Years' Experience in Early Cerebral Aneurysm Clip Occlusion

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Background: The study follows the complete series of patients surgically treated in the past 10 years at Targu Mures Neurosurgery Department and the effects of the surgical experience over the clinical outcome.
Material and method: This is a retrospective study including 382 patients operated in our department between 2001 and 2011 by a team of 5 neurosurgeons.
Results: Out of the 382 patients included in the study 62.17% were female, 37.83% were male with a mean age of 51±30 years. The majority of operated aneurysms were located in the anterior circulation: 363 cases (95%) with the following locations: anterior communicating artery, 167 cases (43.65%), middle cerebral artery, 100 cases (26.3%), posterior communcating artery, 61 cases (16%). In the posterior circulation a number of 19 aneurysms have been operated with the majority (7) being top basilar aneurysms. 86.80% of cases have been admitted in Hunt-Hess I-III, 13.2% being in Hunt-Hess IV-V. A number of 244 patients (64%) have been admitted and operated in first 96 hours from aneurysm rupture, 92 patients (24%) have been operated between 5 to 14 days, and the rest of 46 patients (12%) have been operated two weeks after the first SAH. Outcome has been calculated using the GOS scale: 57.23% of patients have been discharged with GOS 5, 17% with GOS 4, 10% with GOS 2 and 3, while overall mortality was 15.8%.
Conclusions: Multimodality and multidisciplinarity treatments of cerebral aneurysms have improved significantly the outcome of patients but still the surgical treatment represents a major option. In our opinion early surgery represents the gold standard in the treatment of cerebral aneurysms.

Keywords: cerebral aneurysm, clip occlusion, angiography, GOS Scale

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Introduction

Epidemiology of intracranial aneurysms

The most common cause of subarachnoid hemorrhage (SAH) is traumatic brain injury (90%). Spontaneous subarachnoid hemorrhage occurs in 10% of cases and may happen due to ruptured aneurysms (75–80% of cases), cerebral AVMs (4–5%) or it may have an unknown etiology (in 14–22% of cases) [1,2].

Ruptured aneurysms affect mainly the active age (40–60 years old) [3]. They are more common in females and are independently associated with congenital diseases (a defect in the muscular layer of the arterial wall), arterial hypertension, infections (mycotic), neoplastic diseases, head trauma, nicotine abuse and alcohol, obesity and the use of contraceptives [4]. Multiple aneurysms are found in 17–33.2% of patients sustaining a SAH. Interestingly, 19% of the first-degree relatives of patients with SAH are at risk of harbouring an aneurysm [3]. Familial inheritance of IAs is reported with 8.1% (without confounding disorders such as polycystic kidney disease), and it seems that these IAs tend to bleed more frequently than spontaneous aneurysms [5].

Incidence of SAH

From the International Study of Unruptured Intracranial Aneurysms Investigators (ISUIA) the yearly rupture rate for IAs was calculated to be as low as 0.05% [1]. Recent publications have raised the risk figure to 1.3–1.4%, respectively. Risk factors of SAH include the aneurysm size, patient's age, hypertension and smoking. The risk of aneurysm rupture is calculated by size and aspect ratio (dome/neck ratio) [6]. Smaller aneurysms (<5 mm) account for 13% of SAH. Prime target after SAH for the neurovascular specialists is to prevent rebleeding, which will occur in up to 9.7% within 21 days following haemorrhage and is associated with a mortality rate of 40% [7–9]. Owing to the increasing occurrence of vasospasm and ischaemia after day three following initial haemorrhage it is advised to occlude IAs within 72 hours following initial SAH [10,11]. In case of multiple aneurysms it can be difficult to identify the aneurysm responsible for the bleeding. In CT scans haemorrhages might be difficult to link to a distinct aneurysm, if a close location of the aneurysms is given by their parent vessels' proximity, e.g. tip of the basilar artery and posterior communicating artery [3,12,13].

Treatment modalities for intracranial aneurysms

Introduction of electrolytically detachable coils in 1991 has changed the medical practice of the previously 'state of the art' surgical aneurysmal occlusion [14,15]. The ISAT study (International Subarachnoid Aneurysm Trial) favoured endovascular intervention for IAs bearing a lower morbidity and mortality for the patients suffering from aneurysmal SAH when compared with the surgically treated patient group [7,16]. However, long-term follow up showed that endovascular occlusion of aneurysms is associated with a

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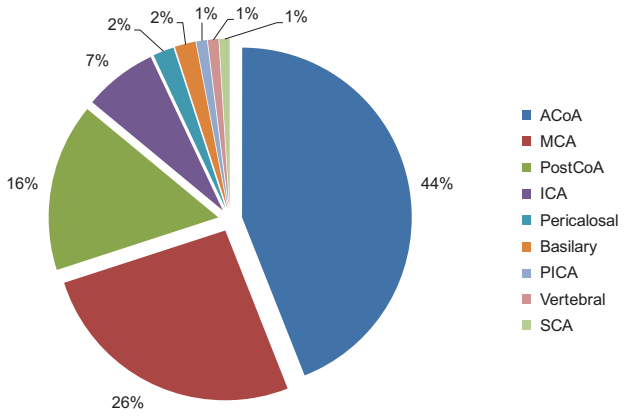

Fig. 1. Ruptured aneurysm location

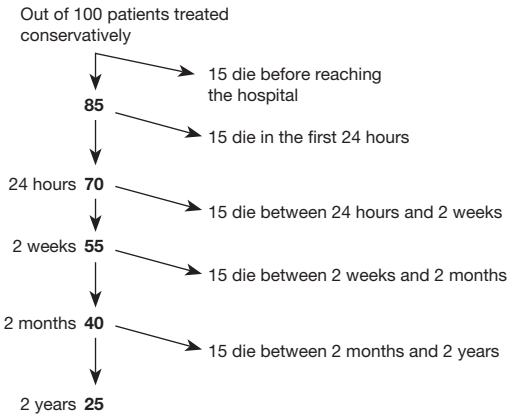

Fig. 2. Natural history of patients with SAH treated conservatively

higher rate of regrowth and consecutive necessity of re-intervention [13]. Nevertheless, numerous studies have been published with the aim of comparing surgical and endovascular aneurysm treatment in order to investigate the superiority of one over the other [17–19].

Our study

The goal of the present article is to suggest a modern treatment philosophy of our neurosurgery clinic that treats all neurovascular abnormalities and their complications (haemorrhage, hydrocephalus, etc.) interdisciplinarily 24 hours a day all year round. The question of whether early or late aneurysm clipping is potentially better has been overcome, as it is our understanding that both treatment modalities are still necessary in a synergistic effort to achieve the best possible outcome for our patients. The modern treatment philosophy must, therefore, consist of an optimized interdisciplinary treatment that is tailored to each individual patient. In our personal experience, numerous highly difficult clinical conditions (multiple and regrowing aneurysms, etc.) may occur, which is why such a philosophy is necessary.

Material and methods

From January 1st, 2001, until December 31st, 2010, medical charts of all consecutive patients undergoing treatment for their IAs in our centre were reviewed by a cross-sectional analysis. Treatment modality was discussed in all cases interdisciplinarily. All patients were clinically examined by a neurosurgeon prior to treatment. Informed consent was granted for elective procedures. In the case of acute haemorrhage the patient's next of kin were informed about the treatment. For most patients angiography (DSA) was the gold standard to decide treatment modality. Computed tomography angiography (CTA) was performed in patients with either thrombosed or partially calcified aneurysms, or if DSA could not be performed immediately in patients with SAH. Patients with occlusive hydrocephalus secondary to haemorrhage received an external ventricular drain prior to DSA.

For study purposes medical charts were analysed for allocation of aneurysms into anterior and posterior circulation, initial clinical conditions of the patient Hunt & Hess (HH), associated SAH/ intracerebral haemorrhage (ICH).

Results

Between January 2001 and December 2010 a total of 384 patients were treated in our clinic for ruptured intracranial aneurysm. The mean age of our patients was 50±31 years. There was a female predominance (62.17%) over males (37.83%).

In our series 68% of patients were admitted in the first 96 hours from aneurysm rupture, more than half of these patiens being admitted in the first 24 hours from rupture.

Hunt-Hess score is known to be an important predictive factor for patients with SAH due to cerebral aneurysm rupture. Upon admission 64% of patients were in a good neurological status (Hunt-Hess I–II), 23% had moderate neurological impairement (Hunt-Hess III), while 13% where severily impaired (Hunt-Hess IV–V).

The vast majority of our patiens had ruptured aneurysms located in the anterior cerebral circulation (95%), only a small percentage (5%) of ruptured aneurysms being located in the posterior circulation.

To assess the outcome of patients who underwent cerebral aneurysm clip occlusion, we have used Glasgow Outcome Scale. Almost 75% of patients were discharged with good or very good neurological function (GOS 5 – 57.23% and GOS 4 – 17%), 10% of patiens were discharged severely disabled or in vegetative state (GOS 2 and 3), resulting an overall mortality of 15.8%.

Mortality was of course influenced by the neurological status upon admittance. In the group of patients in good neurological condition at the moment of surgery (Hunt-Hess I–III) mortality was 10.5% while in the group of patients withe severe neurological impairement at the moment of surgery (Hunt-Hess IV-V) mortality increased to 45.01%.

As for the complications, the two most frequent were vasospasm (diagnostic was made based on clinical observation, head CT and transcranial eco Doppler – Lindegaard ratio >3) encountered in 15.62% of patients and hydro-

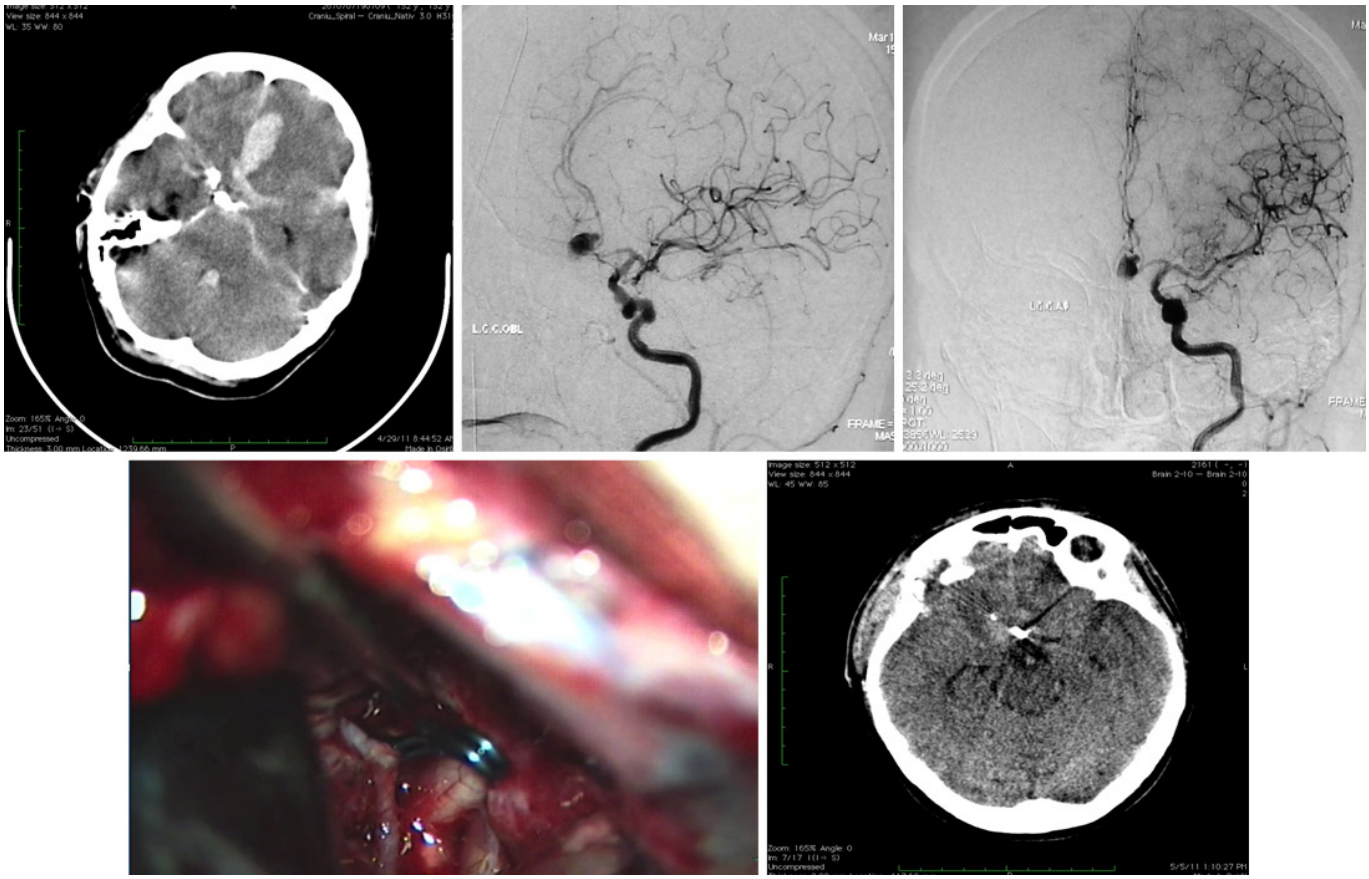

Fig. 3. Anterior Communicating Artery ruptured aneurysm: a) Non-enhanced CT scan showing SAH and ICH with ventricular effraction. b) and c) Anterior and lateral view cerebral angiography showing the A Co Ant aneurysm. d) Intraoperative view of clipped aneurysm. e) Postoperative CT scan.

cephalus (diagnostic made based on clinical observation and head CT) in almost 12% of patients. Other less frequent complications were bronchopneumonia (3.90%), trombembolism (1.30%) and wound infection (0.52%).

Discussions

The exact timing for surgical treatment of cerebral aneurysms is historically a controversial subject in neurosurgery and is dependent on many factors including patient age, aneurysm size, aneurysm location, density of SAH, and whether the patient is comatose [20]. Research indicates that early treatment, within the first 48 hours after hemorrhage, is generally associated with lower overall patient mortality, particularly because of the reduction of two serious complications of rupture: re-bleeding and vasospasm [7,20]. The main disadvantages of early surgery are given by more severe inflamation and brain edema wich can lead to further retraction on an already fragile brain, also increasing the risk of intraoperative bleeding. There is also the risk of an increased incidence of vasospasm due to manipulation of vessels [12,21].

There are some factors that advocate for delayed surgery such as the presence of clinical active vasospasm and CT scans that show a significant cerebral edema. Poor neurological condition (Hunt-Hess grade IV–V) and a difficult aneurysm location (the need for a more lax brain) are also factors that may require a delayed surgery [22].Taking into account that almost half of the patients with SAH die in the first two weeks (see Figure 2), if treated conservatively, early surgery of such patients may increase survival.

Table II. Comparison to the ISAT study

Clinical status, and results	Our series	ISAT	
		Surgical	Endovascular
H&H 1–2	63.54%	88%	
H&H 3	23.17%	8%	
H&H 4–5	13.29%	<4%	
Global mortality	15.1%	9.9%	8%
	Dead or dependent at 2 months		
	26.5%	36.9%	26.1%
HH I–III mortality	10.5%	9.9%	8%
HH IV–V	45.01%		

Comparaison to ISAT study

We have chosen to compare our results to the ISAT study because the latter represents a landmark in the treatement of ruptured cerebral aneurysms [7,16,20].

As it can be seen in the table above the global mortality in our study is significantly higher than the one in the ISAT study (15.1% versus 9.9% int ISAT surgical group). The reason for this is the significantly higher number of patients in poor clinical status (Hunt-Hess IV–V).

The mortality in the Hunt-Hess I–III group is similar in our study with the surgical group of ISAT study (10.5% versus 9.9%).

How can surgical experience affect the outcome of aneurysm surgery?

The Târgu Mureş Department of Neurosurgery has 2 senior neurosurgeons and 3 young neurosurgeons in its vascular team. Two interventional radiologists work alongside with them. In an effort to understand how or if the surgical experience affects the outcome of patients in aneurysm surgery we have studied the case distribution between senior and young neurosurgeons using GOS in order to establish the outcome of patients.

In the Hunt-Hess I–III group, good and very good outcome (GOS 4 and 5) was achieved in 74.64% of patients operated by the senior neurosurgeons, and in 73.43% of patients operated by the young neurosurgeons. Mortality in this group was a little higher (13.33% vs 10.15%) than in patients operated by senior neurosurgeons (not statiscally significant).

In the Hunt-Hess IV–V group we've noticed a significantly higher mortality in patients operated by young neurosurgeons (54.14% vs 39.13%). This may lead to the idea that in patients with poor clinical status, the experience of senior neurosurgeons is critical.

Conclusions

Nowadays, in Romania, both surgical and interventional occlusion of cerebral aneurysms are performed successfully. Multimodality and multidisciplinarity treatments of cerebral aneurysms have improved significantly the outcome of patients but surgery still remains the major treatment.

Advanced imaging techniques also lead to a more precise and thus more frequent diagnosis of cerebral aneurysms.

In our opinion, for Hunt-Hess I–III, early surgery represents the gold standard for treatment. For Hunt-Hess IV–V we consider an early endovascular treatment or late surgery after improvement of neurological status.

We consider that neurosurgeons' experience is critical especially in patients with poor clinical condition upon admission time.

Vascular neurosurgery is a team work in which neurosurgeons, interventional radiologists and neuroanestheologists all contribute to the better outcome of patients with ruptured cerebral aneurysms.

Conflict of interests statement

The authors declare no conflicts of interest in preparing this article.

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